

FEDERAL BUREAU OF INVESTIGATION
FOI/PA
DELETED PAGE INFORMATION SHEET
FOI/PA# 1704204-000

Total Deleted Page(s) = 2
Page 4 ~ Duplicate;
Page 23 ~ Duplicate;

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X Deleted Page(s) X
X No Duplication Fee X
X For this Page X
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(01/26/1998)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE

Date: 06/16/1998

To: Atlanta

From: Atlanta

Squad 11

Contact: SA [redacted] x6363

Approved By: [redacted]

Drafted By: [redacted]

Case ID #: [redacted] (Pending)

Title: UNSUBS, AKA



DBA Mi/Worm;
BHADHA ATOMIC RESEARCH CENTER (BARC),
URL: www.barc.ernet.in,
BHADHA, INDIA - VICTIM;
CEKMECE NUCLEAR RESEARCH CENTER,
ISTANBUL, TURKEY - VICTIM;
CITA MATTER

Synopsis: To open investigation and assign to writer.

Details: Attached are faxes were sent to FBI Atlanta, from the NIPC at FBIHQ. The faxes concern allegations of hackers breaking into computers at India's and Turkey's nuclear research centers.

The allegations include that the hackers used US computers at jpl.nsa.gov, yokipc.navy.mil and dencom.army.mil as intermediary victims to telnet to the computers in India and Turkey. If true, there would be US jurisdiction in the hacking attack.

Atlanta is temporarily OO in this investigation since [redacted] has been tentatively identified, per the attached faxes, as a metro Atlanta resident.

♦♦

6/17/98
SA [redacted]
[redacted]

SEARCHED	INDEXED
SERIALIZED	FILED
JUN 16 1998	
FBI - ATLANTA	

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FD-340 (Rev. 7-29-92)

Universal Case File Number

Field Office Acquiring Evidence

Serial # of Originating Document

Date Received

From

(Name of Contributor)

(Address of Contributor)

By

To Be Returned ☐ Yes ☒ No

Receipt Given ☐ Yes ☒ No

Grand Jury Material - Disseminate Only Pursuant to Rule 6 (e)

Federal Rules of Criminal Procedure

☐ Yes ☒ No

Title:

Reference:

(Communication Enclosing Material)

Description: ☐ Original notes re interview of

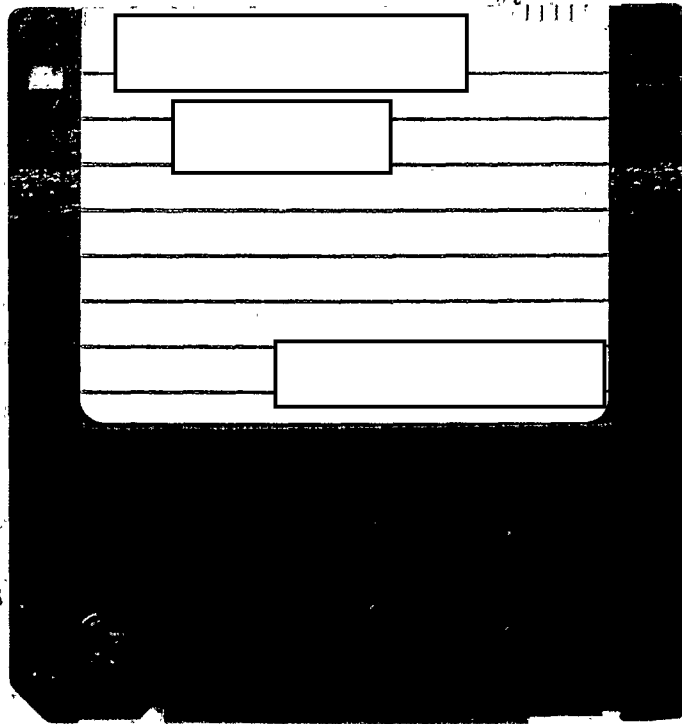
3 Photographs of individual

Known as

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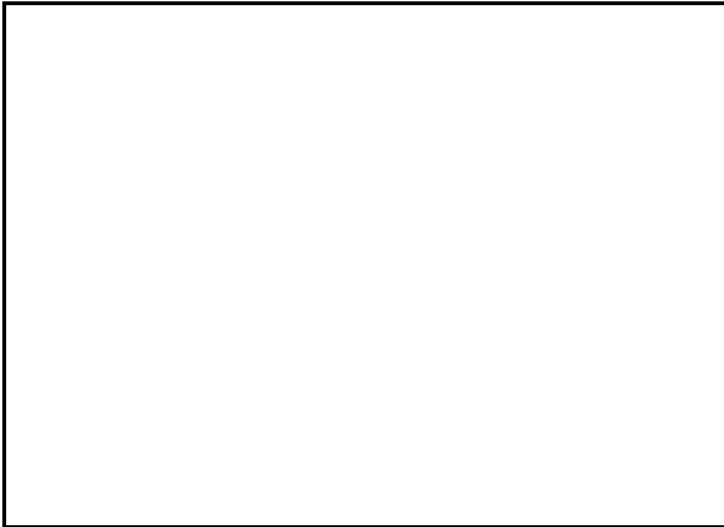
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A:\1246.GIF (local)



1246
1246

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b6
b7C

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE

Date:

To: Atlanta

Attn: SAC
CIP Coordinator

From: Atlanta

SA _____
Squad/RA: _____

Approved By: SSA _____

Drafted By: SA _____

Case ID #: _____ (Closed)

Title: AT _____

Synopsis: Captioned source administratively closed.

Details: Captioned source closed (give reason) _____
_____ on instant date.

If source was a Criminal Informant (CI), must include the following:

Identity of captioned CI was/was not (circle one) revealed.*

*If CI identity was revealed, a separate communication must be sent to FBIHQ, Attention: Sensitive Information Unit, Room 4944, setting forth the details of the revelation and the fact that SAC, Atlanta authorized disclosure and FD-746 was executed.

♦♦

A:\1.GIF (local)

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FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE

Date:

To: Atlanta

Attn: SAC
CIP Coordinator

From: Atlanta

SA _____

Squad/RA _____

Approved By: SSA _____

Drafted By: SA _____

Case ID #: 137 _____ -AT- _____ (Closed)

Title: AT (Former) _____

Synopsis: Conversion of Informant (CI) to Cooperative Witness (CW).

Reference: Date of opening form: _____

Details: The captioned informant is being closed and will be operated as a Cooperative Witness (CW) by the Atlanta Division. This individual will now be carried under the CW file number: _____ and symbol number AT _____ -CW- ____.

Name: _____

DOB: _____

I.D. Numbers: _____

11. Brief description of how CW will be used in an operational role in a substantive case(s) and (A)USA's concurrence (by name and district): _____

(District) _____ (A)USA _____

12. Supervisor approves of the use of the above named individual as a CW as shown in MIOG, Part I, section 270-2. (Supervisor's initials): _____

CC: 1 - 270 _____

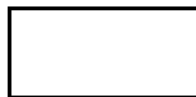
1 - 137 _____

♦♦ (2) Atlanta

MP-702-41

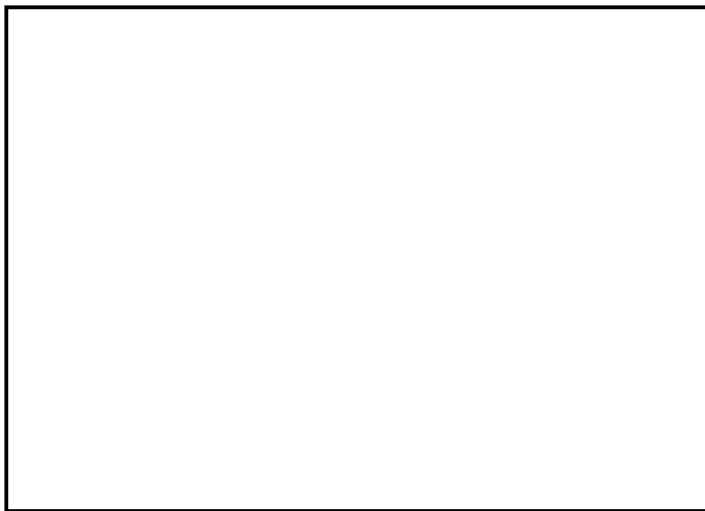


jpg at www.geociti.com



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*** IF CW IS ON FEDERAL PAROLE/PROBATION, CONFIRMING LETTER MUST BE SENT TO U.S. PAROLE COMMISSION, SOUTHEASTERN REGIONAL OFFICE.

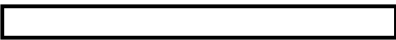
13. IS A PLEA AGREEMENT IN EFFECT/BEING NEGOTIATED: NO___ YES___
IF YES, NAME OF PROSECUTOR_____ DISTRICT OR
COUNTY_____

14. SHOULD IA OBTAIN DL PHOTO? YES OR NO SHOULD IA CONDUCT
LOCAL CRIMINAL CHECK? YES OR NO (CIRCLE YES OR NO ON BOTH)
ASSIGN TO IA:_____

**SAC/ASAC/SUPERVISOR APPROVES USE OF ABOVE NAMED INDIVIDUAL AS A
CW AS SHOWN IN MIOG, PART I, SECTION 270-2. (CIRCLE ONE)

SAC/ASAC/SUPERVISOR'S INITIALS:_____ (ACCORDING TO
#12 ABOVE)



The following investigation was conducted in Atlanta, Georgia on 06/25/1996, by SA 

The attached addresses of HEKTIK.COM and ANTIONLINE.COM with respective contact information, were obtained from rs.internic.net by using the "whois" command.

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SERIALIZED		FILED	
JUN 29 1998			
FBI - ATLANTA			
			

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[rs.internic.net]

Registrant:

Domain Name:

Administrative Contact:

1

Technical Contact, Zone Contact:

Billing Contact:

Record last updated on 16-Feb-98.

Record created on 16-Feb-98.

Database last updated on 25-Jun-98 04:14:22 EDT.

Domain servers in listed order:

b6
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Registrant:

[Redacted]

Domain Name:

[Redacted]

Administrative Contact, Technical Contact, Zone Contact:

[Redacted]

Billing Contact:

[Redacted]

Record last updated on 02-Jan-98.

Record created on 05-Sep-97.

Database last updated on 25-Jun-98 04:14:22 EDT.

Domain servers in listed order:

[Redacted]

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b7C

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b7C
b7E

(01/26/1998)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE

Date: 06/26/1998

To: Atlanta

From: Atlanta

Squad 11

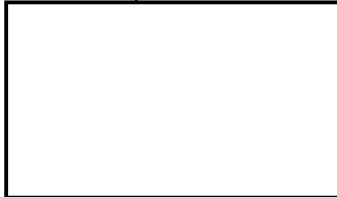
Contact: SA [REDACTED] x6363

Approved By: [REDACTED]

Drafted By [REDACTED]

Case ID #: [REDACTED] (Pending)

Title: UNSUBS, AKA

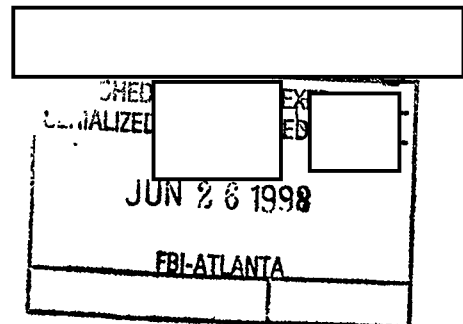


DBA MilWorm;
BHADHA ATOMIC RESEARCH CENTER (BARC),
URL: www.barc.ernet.in,
BHADHA, INDIA - VICTIM;
CEKMECE NUCLEAR RESEARCH CENTER,
ISTANBUL, TURKEY - VICTIM;
CITA MATTER

Synopsis: Information about milwOrm.

Details: Attached are copies of web pages from
WWW.ANTIONLINE.COM which provide further information about the
milwOrm attack on the victim hosts.

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b7E

(01/26/1998)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE

Date: 06/26/1998

To: Atlanta

From: Atlanta

Squad 11

Contact: SA [REDACTED] x6363

Approved By: [REDACTED]

Drafted By: [REDACTED]

Case ID #: [REDACTED] (Pending)

Title: UNSUBS, AKA



DBA MilWorm;
BHADHA ATOMIC RESEARCH CENTER (BARC),
URL: www.barc.ernet.in,
BHADHA, INDIA - VICTIM;
CEKMECE NUCLEAR RESEARCH CENTER,
ISTANBUL, TURKEY - VICTIM;
CITA MATTER

Synopsis: Information about milwOrm.

Details: Attached are copies of web pages from WWW.HEKTIK.COM which list 12 hosts hacked by milwOrm.

♦♦

[REDACTED]	
SEARCHED	INDEXED
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JUN 28 1998	
FBI-ATLANTA	

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fear milw0rm

hacked sites:

www.michaelpowles.co.uk/ was hacked on 5/24/98 by milw0rm before - hacked

www.fantasyfootball.co.uk/ was hacked on 5/24/98 by milw0rm before - hacked

www.dencom.army.mil/ was hacked on 5/25/98 by milw0rm: before - hacked

www.leje.com was hacked on 5/25/98 by milw0rm before - hacked

www.cartoon.co.uk/ was hacked on 5/26/98 by milw0rm before - hacked

www.aps-plc.com/ was hacked on 5/26/98 by milw0rm before - hacked

www.intellimedia.com/ was hacked on 5/26/98 by milw0rm before - hacked

www.intelliprise.com/ was hacked on 5/26/98 by milw0rm before - hacked

www.dyervolve.com/ was hacked on 5/27/98 by milw0rm before - hacked

www.tugmanufacturing.com/ was hacked on 5/27/98 by you guessed it milw0rm before - hacked

www.landrovergeorgia.com was owned on 5/27/98 by milw0rm before - hacked

www.barc.ernet.in/ was owned on 6/02/98 by milw0rm before - hacked

milw0rm in the news:

[Interview with Wired](#) | [milw0rm on antionline.com](#) | [milw0rm on newsbytes.com](#)

[milw0rm on msnbc.com](#) | [milw0rm on CNN.com](#) | [slashdot.org](#)

people who fear:

.gov logs: (who has been looking at milw0rm)

mozart.jpl.nasa.gov - - [03/Jun/1998:18:03:29 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/4.04 [en] (X11; I; SunOS 5.5 sun4m)"

unknown.identity-services.dia.govt.nz - - [03/Jun/1998:23:34:20 -0400] "GET /hacked/milw0rm12.html HTTP/1.1" 200 1804

smtp.hfac.govt.nz - - [04/Jun/1998:01:46:59 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/2.0 (compatible; MSIE 3.01; Windows 95)"

wp.eris.dera.gov.uk - - [08/Jun/1998:03:41:14 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804 "-" "Mozilla/3.04 (Win95; I)"

h188-s110.mcmurdo.gov - - [08/Jun/1998:05:41:35 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.CNN.com/TECH/computing/9806/07/india.hackers.reut/" "Mozilla/3.01Gold (Win95; I; 16bit)"

ec1523518.gsfc.nasa.gov - - [08/Jun/1998:08:58:02 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.wired.com/news/news/email/other/technology/story/12717.html" "Mozilla/4.03 [en] (Win95; U)"

tcs-gateway3.treas.gov - - [08/Jun/1998:09:26:03 -0400] "GET / HTTP/1.0" 200 2677 "-" "Mozilla/4.0 (compatible; MSIE 4.0; Windows

NT)"

host2.pub.whitehouse.gov -- [08/Jun/1998:10:15:09 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.cnn.com/TECH/computing/9806/07/india.hackers.reut/" "Mozilla/3.0Gold (X11; I; OSF1 V4.0 alpha)"

autota.ladpc.gov.il -- [08/Jun/1998:10:52:23 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.walla.co.il/today/mgs.cgi?mid=73&cid=1&layout=msg_lo.1" "Mozilla/4.02 [en] (Win95; I)"

gatekeeper.fcc.gov -- [08/Jun/1998:10:56:14 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/4.04 [en] (Win95; U)"

holmerr.nn.doe.gov -- [08/Jun/1998:11:40:30 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.wired.com:80/news/news/technology/story/12717.html" "Mozilla/3.01C (Win95; U; 16bit)"

viper.gao.gov -- [08/Jun/1998:11:56:37 -0400] "GET /hacked/img/ick.jpg HTTP/1.0" 200 35774
"http://www.hektik.com/hacked/milw0rm12.html" "Mozilla/2.0 (compatible; MSIE 3.0b;

o5j.ctd.ornl.gov -- [08/Jun/1998:12:18:38 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://cnn.com/TECH/computing/9806/07/india.hackers.reut/index.html" "Mozilla/4.05 [en] (Win95; I)"

gate.census.gov -- [08/Jun/1998:12:28:12 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://cnn.com/TECH/computing/9806/07/india.hackers.reut/" "Mozilla/3.01 (X11; I; IRIX 6.2 IP22)"

fcc-bh.auctions.fcc.gov -- [08/Jun/1998:12:42:49 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.cnn.com/TECH/computing/9806/07/india.hackers.reut/" "Mozilla/4.04 [en] (Win95; I)"

cdfsga.fnal.gov -- [08/Jun/1998:13:26:59 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.cnn.com/TECH/computing/9806/07/india.hackers.reut/" "Mozilla/4.05 [en] (X11; I; IRIX64 6.2 IP25)"

vasfw02.fdic.gov -- [08/Jun/1998:13:38:55 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.cnn.com/TECH/computing/9806/07/india.hackers.reut/" "Mozilla/4.0 (compatible; MSIE 4.01; Windows 95)"

lapin.antd.nist.gov -- [08/Jun/1998:13:42:50 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://slashdot.org/articles/9806041836242.shtml" "Mozilla/4.05 [en] (X11; U; SunOS 5.5.1 sun4m)"

edt-proxy-01.edt.gov.ab.ca -- [08/Jun/1998:13:54:35 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.cnn.com/TECH/computing/9806/07/india.hackers.reut/" "Mozilla/2.0 (compatible; MSIE 3.02; Windows 95)"

jdysen-pc.jpl.nasa.gov -- [08/Jun/1998:14:24:11 -0400] "GET /milw0rm/ HTTP/1.0" 200 4488 "-" "Mozilla/3.04 (Win95; I)"

wwwproxy-con.ca.sandia.gov -- [08/Jun/1998:17:56:05 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"file:///Macintosh%20HD/Desktop%20Folder/12717.HTM" "Mozilla/3.0-C-SNL30 (Macintosh; U; PPC) via proxy gateway
CERN-HTTPD/3.0 libwww/2.17"

unknown.proffit.dia.govt.nz -- [08/Jun/1998:22:17:49 -0400] "GET /hacked/milw012.html HTTP/1.1" 404 184 "-" "Mozilla/4.0
(compatible; MSIE 4.01; Windows 95)"

24.138.26.68 -- [08/Jun/1998:22:17:50 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://slashdot.org/articles/9806041836242.shtml" "Lynx 2.5 libwww-FM/2.14"

babylon6.centrelink.gov.au -- [09/Jun/1998:01:03:38 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/4.05 [en] (WinNT; I;Nav)"

mmoxcey.aphis.usda.gov -- [09/Jun/1998:09:00:00 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804 "-" "Mozilla/4.05 [en]
(Win95; I)"

oxygen84.aps1.anl.gov -- [09/Jun/1998:10:17:51 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804 "-" "Mozilla/4.05 [en] (X11;
U; SunOS 5.5.1 sun4u)"

shiraz.nhgri.nih.gov -- [09/Jun/1998:11:15:47 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/4.04 [en] (X11; U; IRIX64 6.2 IP28)"

nsfordsdhp15.ns.doe.gov -- [09/Jun/1998:11:28:07 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
"http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/4.04 [en] (Win95; I)"

frigate.lanl.gov -- [09/Jun/1998:12:55:00 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
 "http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/3.01 (X11; U; IRIX 5.3 IP22)"

k2.llnl.gov -- [09/Jun/1998:15:47:19 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
 "http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/4.04 [en] (X11; U; SunOS 5.5.1 sun4u)"

hffaa.arc.nasa.gov -- [09/Jun/1998:19:26:22 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 304 -
 "http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/4.03 [en] (WinNT; I)" <--once again

rtpc24.nichs.nih.gov -- [09/Jun/1998:20:45:59 -0400] "GET /hacked/milw0rm12.html HTTP/1.1" 200 1804 "-" "Mozilla/4.0 (compatible; MSIE 4.01; Windows NT)"

deaconda.dia.govt.nz -- [09/Jun/1998:21:31:21 -0400] "GET /milw0rm/ HTTP/1.0" 200 4488 "-" "Mozilla/2.0 (compatible; MSIE 3.02; Windows 95)"

www.natlib.govt.nz -- [09/Jun/1998:21:54:16 -0400] "GET /hacked/milw012.html HTTP/1.0" 404 172 "-" "Mozilla/2.0 (Win16; I)"

reynaldo.treasury.govt.nz -- [10/Jun/1998:04:39:04 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 304 - "-" "Mozilla/4.0 (compatible; MSIE 4.01; Windows 95)"

www.mod.gov.sk -- [10/Jun/1998:06:29:39 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
 "http://www.zmije.cz/news/9806/9806051453pzan.asp" "Mozilla/2.0 (compatible; MSIE 3.0; Windows NT)"

vasfw01.fdic.gov -- [10/Jun/1998:07:40:25 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804 "-" "Mozilla/4.04 [en] (WinNT; U; Nav)"

s3abab9.ssa.gov -- [10/Jun/1998:15:41:12 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804 "-" "Mozilla/2.0 (compatible; MSIE 3.02; Win32)"

firewall.linz.govt.nz -- [10/Jun/1998:19:48:26 -0400] "GET /hacked/milw012.html HTTP/1.0" 404 172 "-" "Mozilla/4.0 (compatible; MSIE 4.01; Windows 95)"

proxy.patent.gov.uk -- [11/Jun/1998:07:01:32 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
 "http://www.sky.co.uk/news/tech05.htm" "Mozilla/3.0C-PATSINTER (Win16; I)"

keymaster.dol-esa.gov -- [11/Jun/1998:07:45:36 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
 "http://www.wired.com/news/news/technology/story/12717.html" "Mozilla/3.01 (Win95; I)"

ns1.aac.va.gov -- [11/Jun/1998:08:35:10 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804 "-" "Mozilla/2.0 (compatible; MSIE 3.02; Update a; Windows 95)"

wdcsum1.usdoj.gov -- [11/Jun/1998:13:25:36 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804
 "http://www.tbtf.com/archive/06-08-98.html#s05" "Mozilla/4.05 [en] (Win95; U)"

dhcp216-54.slv.vic.gov.au -- [11/Jun/1998:20:41:51 -0400] "GET /hacked/milw0rm12.html HTTP/1.0" 200 1804 "-" "Mozilla/3.03 (Win95; I)"

...and until you know who the true identities be, send mail care of milw0rm@hektik.com



sent to us by someone who uses the nick M-y_k-E

note to police, federal, and government agencies

FEDERAL BUREAU OF INVESTIGATION
FOI/PA
DELETED PAGE INFORMATION SHEET
FOI/PA# 1704204-000

Total Deleted Page(s) = 1
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X For this Page X
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(01/26/1998)

FEDERAL BUREAU OF INVESTIGATION

Precedence: ROUTINE

Date: 06/30/1998

To: Atlanta

From: Atlanta

Squad 11

Contact: SA [REDACTED] 404) 679-6363

Approved By: [REDACTED]

Drafted By: [REDACTED]

Case ID #: [REDACTED] (Pending)

Title: UNSUBS, AKA



DBA MilWorm;
BHADHA ATOMIC RESEARCH CENTER (BARC),
URL: www.barc.ernet.in,
BHADHA, INDIA - VICTIM;
CEKMECE NUCLEAR RESEARCH CENTER,
ISTANBUL, TURKEY - VICTIM;
CITA MATTER

Synopsis: E-Mail from [REDACTED] in to

[REDACTED] in furnished to Atlanta by HQ IOS [REDACTED]
[REDACTED]

Details: Attached is the above described E-Mail which was sent to Atlanta from the NIPC by NIPC IOS [REDACTED]. The main document attached to the E-Mail appears to be formatted with TeX (pronounced "tek"). TeX is a typesetting system that is used for documents that contain a lot of mathematics. TeX is a macro processor with programming capability. Information on TeX can be found on the Internet pages of the UK TeX user's group at

[REDACTED] TeX is a common application usually included with the Linux operating system.

♦♦

[REDACTED]

SEARCHED	INDEXED
SERIALIZED	FILED
JUL 1 1998	
FBI - ATLANTA	

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From [redacted] Mon Oct 20 20:32:15 1997
Return-Path: [redacted]
Received: from [redacted] by [redacted] (4.1/SMI-4.1)
id AA07165; Mon, 20 Oct 97 20:29:04 IST
Received: from [redacted] with ESMTP
(peer crosschecked as: [redacted])
id QQdman21249; Mon, 20 Oct 1997 01:22:53 -0400 (EDT)
Received: from [redacted] (8.8.5/SMI-SVR4)
id KAA05549; Mon, 20 Oct 1997 10:40:16 -0500 (GMT)
Date: Mon, 20 Oct 1997 10:40:16 -0500 (GMT)
From: [redacted]
To: "Test account - Temp." [redacted]
Subject: Re: Further Infos!
In-Reply-To: [redacted]
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
Status: RO
X-Status:

Dear [redacted]

I received both the mails of 17th and 18th today. I did not come on Saturday. I overlooked the isomeric nature of the 2530 keV level in Pm141 which de-excites by 639-381-882 keV cascade. It now appears certain that this level is fed by 43 keV transition from the isomer. Indeed, we have seen enhanced 43 keV in all the three gates, viz., 882,381 and 639 keV and not with the others we have placed above 882-381 in Pm142, viz., 148,175 and 1548 keV. This you may once more check. So the 43 keV, which was somewhat not possible to account for, if we accept its placement in Pm142 and the placement of 882 keV gamma-ray in Pm141 could be finalised. The slight increase in the yield of 882 in our alpha data could be accepted because at lower energy, the population of the isomer may be more which stabilises after some threshold energy of the projectile. In F19 reaction, the population takes place at a higher energy and because of that one might see some changes in the feeding intensities and the rel. int. of 728 and some other gammas lying below the so called 2 microsec isomer. Please comment on these arguments. 991 keV was seen by 47 MeV alpha expt. but not in 55 MeV alpha run. This points to the fact that this is more likely in 142Pm which, of course, have to be established by some arguments and our alpha exc. function data. I shall check for the presence of this and accompanying gammas today. More in the next. Regarding your DCO analysis. I shall write in my next mail. Bye now.

[redacted]
10h45
20/10/97

On Fri, 17 Oct 1997, Test account - Temp. wrote:

> [redacted]

> I could see the paper on Pm141 from alpha run and the heavy ion
> paper. In that heavy ion paper they have already mentioned about some
> discrepancy in connecting the 882-728 cascade with the higher spin states,
> they are saying there is some totally converted low energy transition which
> was not possible to see in the expt. . In alpha run also they are mentioning
> about some intensity balance problem for that >2 us state. But why these

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> people observed 381 (which is actually feeded by that 639 from this
> metastable state) is not seen at all in the heavy ion work ? This
> particular isomeric state & the cascade 639-381 from thsi state are
> not observed in heavy ion work. In our level sceme the 728 I have
> placed is connected with other new transitions like 143-221-1379 etc. which
> are not present in any of the Pm141 work, though 882 is there in coincidence
> but that I had explained as may be that there are some contribution actually
> from Pm141 in this 728 gate. So in that sense 882 is there in Pm141.
> We have to choose a good target projectile combination to do a full fldged
> expt for Pm141 also so that to populate high spin as well as with good
> statistics with less contamination from the neighbouring channels to solve
> these discripencies. But whether the whole lot of things connecting 992
> which I have placed can be from Pm141 ? I don't think so, at least if
> PACE calculation is right at that beam energy.
> Bye for today,
>
> with regards,
> [redacted]
> 17-10-97
> 6 p.m.
>

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From: [redacted] n Wed Oct 22 19:24:31 1997
Return-Path: [redacted]
Received: from [redacted] by [redacted] (4.1/SMI-4.1)
id AA11763; Wed, 22 Oct 97 19:24:18 IST
Received: from localhost by [redacted] (8.8.5/SMI-SVR4)
id TAA24200; Wed, 22 Oct 1997 19:13:39 -0500 (GMT)
Date: Wed, 22 Oct 1997 19:13:39 -0500 (GMT)
From: [redacted]
To: "BARO [redacted]"
Subject: On Pm142 scheme
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
Status: O
X-Status:

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Dear [redacted]

Further to my comments on Pm142 scheme, I checked the other part on the right of the main cascade starting with 991 keV. Most of the assignments are found consistent except 205 and 1042 keV which you have placed below 249 keV. Firstly, the data for those gates are without multiplicity gating and then 205 is very much polluted with 208 and 203 keV from beolw the isomer. Also, one sees in 143 and 221 gate 330 and 278 keV. This could not be sorted out. may be the background subtraction is improper in those cases. I shall look into it tomorrow. Bye now

[redacted]
19h30
22/10/97

From: [redacted] n Sun Jan 4 10:04:02 1998
Return-Path: [redacted]

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Received: from [redacted] by [redacted] (4.1/SMI-4.1)
id AB07125; Sun, 4 Jan 98 10:02:47 IST
Received: from [redacted] by relay4.UU.NET with ESMTP
(peer crosschecked as: [202.41.93.3])
id QQdwso11897; Sat, 3 Jan 1998 07:37:58 -0500 (EST)
Received: from localhost by [redacted] (8.8.5/SMI-SVR4)
id SAA14688; Sat, 3 Jan 1998 18:06:23 -0500 (GMT)
Date: Sat, 3 Jan 1998 18:06:22 -0500 (GMT)
From: [redacted]
To: "BARC" [redacted]
Subject: Some Infos!
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
Status: O
X-Status:

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Dear [redacted]
I am in office on a Saturday after quite sometime. How are you? No mail in response to my mails. I sent a mail to you last evening. Did you receive it? We have got a beamtime at TIFR provisionally from Jan.17-22, which was informed only yesterday. As this run is long overdue, we have decided to accept it and accordingly, [redacted] and self would start on 14th by Bomabay Mail via Nagpur to reach on 16th. This run may slide by 2-3 days; so return journey date could not be fixed. This time I am travelling by train, primarily for fund problem and also to assure that [redacted] can go by air. Also, I need to start early to receive [redacted] at VT with trunkfull of equipments, as it happened last time. So it is better to accompany her. I have not travelled by train to Bombay for last couple of years. I hope I shall be able to stay for few more days if the beamtime starts on time. In that case, I shall shift to TSH and plan to work with you on the final drafts. I have sent a mail to [redacted] seeking the information on beamtime and their comments on the draft of 142Pm paper. That's all for the present. When have booked your ticket? Have you received the forms from [redacted]? Your Group Director may like to see the synopsis before signing it, isn't it? So you need to write up your synopsis, too. Bye now.

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Best wishes,

[redacted]
18h00
3/1/98

From: [redacted] Wed Jan 28 11:18:27 1998
Return-Path: [redacted]
Received: from [redacted] by [redacted] (4.1/SMI-4.1)
id AB23202; Wed, 28 Jan 98 11:16:11 IST
Received: from [redacted] by [redacted] with ESMTP
(peer crosschecked as: [202.41.93.3])
id [redacted] Tue, 27 Jan 1998 08:47:42 -0500 (EST)
Received: from localhost by [redacted] (8.8.5/SMI-SVR4)
id TAA04040; Tue, 27 Jan 1998 19:15:02 -0500 (GMT)
Date: Tue, 27 Jan 1998 19:15:00 -0500 (GMT)
From: [redacted]
To: "Test account - Temp." [redacted]
Subject: Update!

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In-Reply-To: [redacted]
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
Status: O
X-Status:

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Dear [redacted]

I sent a mail in the morning immediately after it reached here. I was logged on at that time. Still no formal communication from NSC; however, one letter has come from [redacted] in connection with the data back-up from tape to Exabyte or CD-ROM, about which you are aware. As we don't have any tape there and we have already exabyte back-up, I think we need not have to take any action. [redacted] once mentioned that our things whatever was there on disk has been backed up. In his last mail, [redacted] has informed that there is serious problem in HP hard disk there; most likely, it has crashed and they (students) are very much perturbed. He is coming here on 10th or 11th. No reply either from [redacted] According to [redacted] (I met him today; their paper on 138Pm has been accepted in Nucl. Phys.), they don't send the draft to [redacted] for comments as on earlier occasion, they did not receive any comments on the draft. I think I shall write one more mail to [redacted] and just send the paper. [redacted] has not come today; as [redacted] has not come to office, most likely, she reached safely yesterday. [redacted] has progressed nothing during last one week; so I had to brush him little bit today. Still he has not progressed much during the day. I finally sat with him for an hour or so after tea. I think if you are coming here, the first job for you would be to get all the projected spectra of interest from VEC run to back-up in NSCSORT PC compatible files. Tomorrow and day after tomorrow, I am supposed to go to IUCC for their project review meeting. Your present divn. name is Radiation Physics & Advisory Division - is it correct? Pl. let me know. I have taken out a printout of the paper which is just 5 pages (double spaced) including abstracts and without figures. It is just little more than Z.Phys. short note, but may go very well as a Brief Report for PRC. Still in a dilemma as to what to do. I am wondering if one should elaborate some of the points which we condensed keeping Z.Phys. in mind. Pl. let me know. Bye now. Best wishes,

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[redacted]
27/1/98
19h10

From: [redacted] Wed Mar 11 15:17:40 1998
Return-Path: [redacted]
Received: from [redacted] n by [redacted] (4.1/SMI-4.1)
id AA02411; Wed, 11 Mar 98 15:16:51 IST
Received: from localhost by [redacted] (8.8.5/SMI-SVR4)
id PAA18600; Wed, 11 Mar 1998 15:14:54 -0500 (GMT)
Date: Wed, 11 Mar 1998 15:14:54 -0500 (GMT)
From: [redacted]
To: "Test account - Temp." [redacted]
Subject: Re: your mail
In-Reply-To: [redacted]
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII

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Status: O
X-Status:

Dear [REDACTED]

I was little busy today in the morning; there was a meeting of the Annual Report Editorial Committee. I could check my mail now and saw both your mails. There was no problem at Jadavpur; in fact, I need not have gone. For [REDACTED] biodata they started to read; but when it came to your case (it was the last case) [REDACTED] told the Chairman in advance that he has seen the case and it may be approved. I checked with the clerk, [REDACTED] who received your application. He says that there would be a formal meeting of the PH.D committee after which they would issue the letter. After that you have one month time to deposit the fee. Probably, you may ask your brother to submit the application for Migration certificate. And for depositing the fees, I don't know whether you need to come personally for that. I shall check with [REDACTED] if your signature is required. You may mention to [REDACTED] that you are working with me and the problems you face in a common a/c. If necessary, I may write to him. Anyway, when I go to BARC next time, I shall certainly talk to him and introduce you to him in case you require some computation support. That's all for now. Try to write up the first draft for 143Pm at the earliest. With best wishes,

[REDACTED]
15h10

11/3/98

P.S. I talked to [REDACTED] to enquire the procedure for depositing of [REDACTED] fee. He says that with the migration certificate, if one goes, they would give you the original form and ask you to deposit the fee at the cash office. That's all. So on your behalf, anybody can do this with your letter of authority. The time is one month from the date of issue of the letter. As it would come to me, I may do the job on your behalf if necessary.

From: [REDACTED] Wed Mar 11 19:00:29 1998
Return-Path: [REDACTED]
Received: from [REDACTED] by [REDACTED] 4.1/SMI-4.1
id AA12148; Wed, 11 Mar 98 19:00:00 IST
Received: from localhost by [REDACTED] 8.8.8/SMI-SVR4
id SAA02142; Wed, 11 Mar 1998 18:58:10 -0500 (GMT)

Date: Wed, 11 Mar 1998 18:58:09 -0500 (GMT)

From: [REDACTED]

To: "BARC" [REDACTED]

Subject: Infos!

Message-Id: [REDACTED]

Mime-Version: 1.0

Content-Type: TEXT/PLAIN; charset=US-ASCII

Status: O

X-Status:

Dear [REDACTED]

I hope you received my earlier mail. In one of the Jan'98 issues of Nuclear Physics A (in VECC NPA is not coming due to funding constraints), I saw yesterday at SINP, there is a theoretical paper on N=82 odd-A nuclei. I have to get it copied from SINP. Pl. go through that paper. There is no reference to any other exptl. paper on 143Pm yet. The

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JU person, [redacted] came to VECC in the afternoon. I met him. Your letter is expected to come to me after 25th, according to him. Migration certificate in original would be required, while deposing the Regn. fee. So you may ask [redacted] to submit your application to Cal. Univ. at the earliest. Nothing more at the moment. Best wishes once again,

[redacted]
19h00
11/3/98

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From: [redacted] Thu Apr 23 18:35:51 1998
Return-Path: [redacted]
Received: from [redacted] ([202.41.93.3]) by magnum (4.1/SMI-4.1)
id AA01532; Thu, 23 Apr 98 18:34:26 IST
Received: from localhost by [redacted] (8.8.8/SMI-SVR4)
id SAA27700; Thu, 23 Apr 1998 18:31:10 -0500 (GMT)
Date: Thu, 23 Apr 1998 18:31:10 -0500 (GMT)
From: [redacted]
To: "BARC" [redacted]
Subject: cqj633 (fwd)
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
Status: O
X-Status:

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Dear [redacted]
Below please find the report received from PRC. Had it come two days back, we could have discussed and settled the issue. Though it appears that I am passing a phase of bad luck, but I feel that the paper can be rewritten and made acceptable to the referee. The later part of the report on language requirements you may ignore. Please go thru' the actual report very critically and try to write/indicate the necessary changes in the manuscript during the weekend and write to me. I shall be coming either on Saturday or on Sunday, depending on whether I go to Chetla when. I just phone to your house and talked to your mother. Everybody is fine. She was enquiring whether you have any plans to go to Delhi or to come here. I just mentioned that you might go to Delhi for a talk. That's all on your home front. Your letter from J.U., I have read. I shall talk to [redacted] at his house tomorrow morning and enquire on the issue of residence requirement. I plan to go to J.U. next Wednesday, if I am back on Tuesday from Shantiniketan. Should I show the report to [redacted] What do you say? I may just mention if he has heard from [redacted] Otherwise, I am in favour of telling them when it is accepted. They have not done their job; they should have send their comments which they didn't bother to do. Had I been in their place, either I would have opted out to be a co-author or have made constructive comments for improving the quality of the paper. Our train reached Howrah around 11-20 AM. Fortunately, [redacted] was there and the vehicle was waiting. [redacted] did not accompany us as [redacted] was there. They could have easily come and take a taxi from VIP crossing. I did not press much. By the way, did you write anything to [redacted] on our run? If you have not written, then pl. don't elaborate it much, as [redacted] opted to report 50% success of our run. I don't think [redacted] would agree to come soon; I would try once and then push your proposal. I have already talked to [redacted] keeping both options open and told [redacted] that

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depending on the situation, I shall send the beamtime request form. I am going to rewrite the part as per [] suggestion and send it to you so that you can talk to him in person. One thing he expressed very clearly that day. That is, he or his group members won't be able to help much in data analysis. I have also very clearly told that it won't be a problem for you to do the analysis which you have been doing with the NSC data. It is already very long. I wish I could give you a good news. But that did not happen. But it's not a hopeless case, too and may be, if we incorporate the suggestions of the referee, it would be a full paper. But the comments on the theoretical part, I don't know how to do. I shall go thru' tonight and shall come back to you tomorrow. Pl. reply on receipt of this mail. With best wishes,

[]
18h15
23/4/98

P.S. Please give the x-section values we estimated for the observed channels, which the referee wants us to include and also the DCO ratio definition. But I don't understand how one can give so much of details in a brief report. May be, we have to incorporate some of the suggestions positively; but some of the things like the above mentioned issues can be clarified in a separate write-up for referee. Also, some modifications in figs. seem to be necessary. [] has, so far, not sent any mail from NSC. I could reach office today only at 2-30PM; then had to clear the material from the gate. Then one [] from OXFORD was waiting for me in connection with the problem of HPGe detectors. That's the reason for the delay in writing the mail. You might have visited BARC during the day to check your mails. If it is so, then you may not be seeing this mail before tomorrow. Anyway, pl. acknowledge this mail even if you are not ready with all the information I have asked.

----- Forwarded message -----
Date: Wed, 22 Apr 1998 12:56:26 -0400 (EDT)
From: []
To: []
Cc: []
Subject: cqj633

CQJ633
High spin states in doubly-odd ^{142}Pm

Dear []

The above manuscript has been reviewed by one of our referees. Comments from the report are enclosed.

These comments suggest that considerable revision of your paper may be in order. If you resubmit your manuscript, please include a summary of the changes made, and a brief response to all recommendations or criticisms.

Sincerely,

[]

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P.S. We regret the delay in obtaining this report.

Referee Report:

This paper is based on some reasonable experimental work which resulted in a considerable extension of the previously known level scheme of ^{142}Pm . However, in my opinion a thorough revision and partly rewriting is necessary in order to make it a suitable publication. Especially, the interpretation of the experimental data should be more detailed.

Although the experimental setup is quite compact, the description of the detector geometry is hard to understand. The paper given as a reference describes a previous version of the setup. The authors don't give a definition of the DCO ratio they employ in order to determine the multipolarities. This makes it complicated to calculate the expected DCO ratio when gating on a stretched quadrupole transition and looking at a stretched dipole transition.

It would have been useful not just to mention that the relative cross sections are consistent with PACE2 calculations, but also to give some numbers, especially since the reaction channels are not selected by detecting emitted particles or the residual nuclei.

Spin and parity of the 10-, 11-, 13- and 15- levels are called "tentative" in the text (p.5 bottom) but not marked as such in the table or the level scheme.

In some levels, the intensity of the feeding transition(s) is much larger than the depopulating one (i.e. 1940.6 keV, spin (10)). Since the difference is by far larger than the sensitivity of the setup, this requires some discussion.

In the titles in fig. 1 the energies are not rounded correctly. In the upper picture, 192.4 should be 192.5 according to the level scheme. The 208.5 keV transition is a doublet and should be marked with (d).

The presentation of the level scheme in fig. 2 should allow the reader to follow the main flux of the gamma ray intensity above the 8- isomer from the width of the arrows.

The interpretation of the experimental data contains a brief summary of the work by  et al. (reference 13 in the text) and one sentence that the new discovered negative parity states above the 8- isomer are suggested to be based on a $1h11/2$ excitation. No calculations have been performed. A comparison with neighbouring nuclei is mentioned in the presentation of the level scheme, but not shown and systematics are not discussed. This part of the paper is not suited to be published in the Physical Review.

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The whole paper needs some linguistic improvement.

ef2.asc
new 6/93

Language Requirements

Manuscripts submitted for publication in Physical Review should be clearly written in good scientific English, in a style consistent with that of the journal (see Editorial Policies and Procedures at the front of the first issue of each volume of the journal). With this requirement in mind, authors should carefully review and proofread their papers before submittal. In particular, authors whose native language is not English are urged to seek help from a native English speaker.

Minor mistakes in grammar or orthography can often be corrected by the copy and technical editors of the journal. It is not possible, however, for the editorial office to undertake extensive corrections of manuscripts, due to time constraints as well as the risk that the authors' meaning might be distorted. Those manuscripts requiring extensive corrections are, therefore, returned to the authors.

We request that you revise your manuscript with the aid of a colleague whose native language is English.

elec_sub.asc
revised 7/97

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Figures for an electronic submission must be received in at least review-quality form before editorial processing can begin. Web upload or electronic-mail transmission (one figure per file) of PostScript-formatted figures will normally meet this need. For color or continuous-tone PostScript figures, hard-copy originals are also required. The originals are needed to ensure that the reproductions created from the electronic

figure files are satisfactory. (For email transmission, use a subject line similar to that for the text file with the addition of the figure number, e.g., "submit pra jones fig1".) Alternatively, you could send scanner-reproducible journal-quality "originals" immediately by overnight mail. A third possibility is to send review-quality figures by fax (516-591-4141), while the "originals" are sent by conventional or overnight mail as soon as possible; please mark the fax transmission as being part of an electronic-mail submission. On resubmission, it is only necessary to resend your figures if the originals in our file are no longer valid.

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A diskette submission should be accompanied by a single paper copy of the manuscript, and by scanner-reproducible "original" figures.

Include the copyright transfer form with the original figures or forward it alone by conventional mail. An electronic version of the form is available at the URL <http://publish.aps.org/> or via ftp to <ftp://publish.aps.org/> in the /pub/jrnls directory, as the files copytrnsfr.asc, etc. (but do not return it electronically, as we need a handwritten signature).

It is important to confirm the accuracy of bibliographic information in references. This has become more important now that the journal is online. Hyperlinks will be programmed to enable readers to "click" on references and jump directly to the material cited. If your reference citations are incorrect or incomplete (e.g., missing author name, or an incorrect volume number or page), the associated hyperlinks may fail, and the usefulness of your paper in the online environment may be diminished.

Resubmission must be in electronic form if the paper is to remain eligible for the production compuscript-conversion program. Also, macros and other technical problems with the file which have been pointed out by our compuscript staff must be eliminated by this stage if the paper is to remain eligible. Resubmission forms are available at <http://publish.aps.org/ESUB>. For an email resubmission, include the filled-out form as the first part of the message which contains the modified manuscript; alternatively, provide as the first part of the message a summary of changes made and a brief response to all recommendations and criticisms, and also state whether or not the figures have been modified, and update any other relevant information. Use as the subject of the message "resub" followed by the manuscript code number and the last name of the first author; for example, "resub AB1234 Smith" or "resub ab1234 smith".

For further information about procedures for electronic submission, see the General Information for Contributors published in the first issue of each volume of the journal, and material available on APS' ftp and World Wide Web servers. In particular consult the document at the URL <ftp://aps.org/pub/jrnls/esubinform.asc> or visit the Web-submission page <http://publish.aps.org/ESUB>.

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- * For other information:
APS Research Journals home page <http://publish.aps.org/>

From: [REDACTED] Wed May 13 19:58:13 1998

Return-Path: [REDACTED]

Received: from [REDACTED] (4.1/SMI-4.1)

id AA20635; Wed, 13 May 98 19:57:48 IST

Received: from localhost by [REDACTED] (8.8.8/SMI-SVR4)

id TAA07067; Wed, 13 May 1998 19:53:24 -0500 (GMT)

Date: Wed, 13 May 1998 19:53:23 -0500 (GMT)

From: [REDACTED]

To: "BARC [REDACTED]"

Subject: Good News!

Message-Id: [REDACTED]

Mime-Version: 1.0

Content-Type: TEXT/PLAIN; charset=US-ASCII

Status: RO

X-Status:

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Dear [redacted]

You would be glad to know that the INPC-98 organising committee has extended full financial support for local stay during the conference and has waived the Regn. Fee. So the chances of getting deputation & travel support from the dept. might be possible now. I have to now cross the next hurdle to get this through from [redacted] In the event of the recent N-tests (two more have been done today morning), I do not know what would be the policy of the government. Let us see how it takes shape. I should thank you as the most active contributor of the work and wish that such chances would come to you in future. Yes, [redacted] has finally submitted resignation. I could not meet [redacted] as he has not come to office today. I could not also do much work today. I have decided to cancel my proposed leave from the next week. So hopefully, I shall be able to finish the work on 142PM manuscript and the proposal for your expt. at TIFR [redacted] run, we would take at a later day. We may propose to do this expt. at Strasbourg, if possible, with a multidetector set-up. That's all for now. Best wishes,

[redacted]
19h55
13/5/98

From: [redacted] Wed May 20 20:02:33 1998
Return-Path: [redacted]
Received: from [redacted] (4.1/SMI-4.1)
id AA19727; Wed, 20 May 98 20:01:51 IST
Received: by [redacted] (8.8/SMI-SVR4)
id TAA26519; Wed, 20 May 1998 19:57:33 -0500 (GMT)
Date: Wed, 20 May 1998 19:57:33 -0500 (GMT)
From: [redacted]
Message-Id: [redacted]
To: [redacted]
Subject: Draft Proposal for TIFR
Status: O
X-Status:

Dear [redacted]

Are you too busy? There is no reply to my mail sent in the mor-ng! I am sending herewith the draft proforma and a .tex file for scientific motivation. I removed the beam-pulsing requirement, because two beams we have as-ked and in addition, if we ask for pulse beam, even Jain may not agree. But on line if there is a scope, we can ask. Please send your comment by tomorrow so that I can fax it latest by Friday morning. That's all for now. With best wishes Swapanda
20/5/98
20h05

Proforma:

PELLETRON ACCELERATOR FACILITY
BARC-TIFR

Beam Time Request Form

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1. Name of the Investigators [redacted] VECC
with affiliation * [redacted] BARC

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[redacted] SINP
[redacted] and
[redacted] TIFR

2. Title of the experiment : Neutron-Gamma Coincidence Studies
following $^{133}\text{Cs}(^{12,13}\text{C}, \text{xn})$ reactions

3. Specific motivation of the : Please see Annexure
experiment

4. Beam specifications : ^{12}C , ^{13}C ; $E = 50\text{--}65$ MeV; 2pA.
(Particle, energy range,
current etc.)

5. If beam pulsing required : No

6. Beam line to be used : 30 deg south

7. Details of the experimental : Thick ultra-pure $^{133}\text{CsNO}_3$ target;
arrangement and measurement Neutron Array of 6 NE213 detectors;
(Targets, detector type and HPGe Clover detector.
configuration etc. to be given)

8. Beam time required : 12 shifts
(Shifts of 8 hrs.)

9. Dates which you do not want : June 15 - June 30 & July 20 - August 8
the machine

10. Contact telephone Nos. : (033) 337 1231 (off.)
(Official/Resident) (033) 555 5418 (res.)

[redacted]

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Date : May 21, 1998

Spokesperson

Annexure:

`\documentstyle[preprint,aps]{revtex}`

`\title{\underline{ANNEXURE} \\`

`Scientific Motivation and Outline of the Experiment}`

`\begin{document}`

`\draft`

`\maketitle`

`\space{1 cm}`

The doubly-odd Pm-nuclei with $Z=61$ and $N \leq 80$ have been
studied in recent years using heavy ion reactions $\text{cite}\{1,2,3,4\}$.
Recently their counterparts with $N \geq 83$ have been investigated

and a high spin yrast isomer ($\geq 2 \mu$ s) at $I = 27^+$ have been discovered in $N=83 \text{ }^{144}\text{Pm}$ which is being considered as a potential isomeric beam for acceleration and use in nuclear spectroscopic studies [5]. The near-spherical ^{142}Pm nucleus, however, has not been studied in detail to higher spins till recently. Prior to our study of the reaction $^{141}\text{Pr}(\alpha, 3n\gamma)^{142}\text{Pm}$ using α -particles from VEC, Calcutta [6], the only information concerning the excited states in ^{142}Pm comes from the work of [] et al. [7] who studied the γ -rays and conversion electrons following (p,n) and (d,2n) reactions on ^{142}Nd and proposed a level scheme upto 1.2 MeV excitation, consisting of a 2ms 8^+ isomer at 883 keV. In a recent study [8] using the Gamma Detector Array (GDA) at Nuclear Science Centre, New Delhi, we have investigated the reactions $^{135}\text{Ba}(^{11}\text{B}, 4n)$ and $^{133}\text{Cs}(^{13}\text{C}, 4n)$ with a view to explore the high spin structure of near spherical Pm-nuclei close to $A=140$. In the latter reaction, we assigned tentatively a set of γ -rays, having no coincidence relationships with the known γ -rays from the neighbouring channels, produced in the same reaction. Some of those were weakly observed in our $(\alpha, 3n\gamma)$ study [6], but could not be firmly assigned. Based on only γ - γ coincidence data we have tentatively constructed the level scheme above the 2ms isomer in ^{142}Pm upto an excitation energy of 5.1 MeV and spin $19\hbar$, which warrants unambiguous isotopic assignment of the new set of γ -rays to ^{142}Pm . We propose to undertake this assignment by excitation function measurements of the said γ -rays using the reaction $^{133}\text{Cs}(^{13}\text{C}, 12\text{C}, xn)$ reaction at $E = 50\text{--}65$ MeV by γ -ray singles and neutron- γ coincidence measurements. It is proposed to use the six-element Neutron Array Facility of TIFR and a high efficiency HPGe Clover detector for this purpose.

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\begin{references}

- \bibitem{1} []
[]
Z. Phys. {\bf{A347}}, 93 (1993).
- \bibitem{2} []
[] Phys. Rev. C {\bf{42}}, 541 (1990).
- \bibitem{3} []
[] Phys. Rev. C {\bf{36}}, 1810 (1987).
- \bibitem{4} []
[] Nucl. Phys. {\bf{A526}}, 188 (1991).
- \bibitem{5} [] et al., Z. Phys. {\bf{A345}}, 123 (1993).
- \bibitem{6} [] (Unpublished, 1996).
- \bibitem{7} []
[] Nucl. Phys. {\bf{A274}}, 61 (1976).
- \bibitem{8} [] et al, Phys. Rev. C. (under review)

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\end{references}

\end{document}

From: [redacted] n Thu May 21 13:32:54 1998
Return-Path: [redacted]
Received: from [redacted] (4.1/SMI-4.1)
id AA17131; Thu, 21 May 98 13:31:07 IST
Received: from localhost by [redacted] (8.8.8/SMI-SVR4)
id NAA07156; Thu, 21 May 1998 13:25:38 -0500 (GMT)
Date: Thu, 21 May 1998 13:25:38 -0500 (GMT)
From: [redacted]
To: Temp Area [redacted]
Subject: Re: Updates!
In-Reply-To: [redacted]
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
Status: O
X-Status:

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Dear [redacted]

I hope you got my mail sent today morning. I have gone thru' your transferred file and is very happy to note your critical comments. All the points, you have raised are good points for reconsideration. I shall check the fig. on level scheme; as [redacted] has decided the widths of the arrow on the basis of gamma intensity, it should be o.k.. Regarding DCO ratio, let us keep whatever we have incorporated. I think the exptl. set-up part is o.k. In literature, anti-compton shields and anti-compton spectrometers are sometimes synonymously abbreviated as ACS and CSS is used for copmton suppressed spectrometer. I have used in the text ACS where I described the shield and CSS when I required to mean shield + HPGE detector. Regarding the last para, I am also not satisfied but there is not much to write also. My statement "calculation not feasible is very correct"; but as you have indicated one may avoid that statement also. Anyway, I shall revise to the extent I feel necessary and have plans to show it [redacted] They are going to IOP for an expt this weekend. Yesterday I was expert for the promotion interview of [redacted] [redacted] It was just a formality and I had to ask some questions. And for that I had to do some preparations, too. Sometime back, I had some talk with CKK in connection with your transfer. Probably, [redacted] must have discussed with him about CHPR's resignation and the possibility of your transfer; but CKK feels that it won't be good for you and from the point of view of our interest to get your involvement in our activities. Actually, I went to him to see the exact requirements that have gone for T. S. manpower. We have asked for 3 physicists this time and in that note mention is there of my project also. But this year I don't know how many are there and how many we might get? Then last year's topper, [redacted] has already been transferred to Physics; so one person would go there and if one more person is available, then between [redacted] and me, it would be decided. You can guess how do I stand in that decision. Anyway, one good thing is that he has agreed in principle to give me deputation and travel support for trip to France. But now as [redacted] has got full local support today from conference committee, he is also going to ask for

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deputation. Under the circumstances, it has become little delicate. [redacted]
[redacted] already turned down his case yesterday while talking to [redacted]
Today [redacted] was supposed to see him. I don't know the result yet. Anyway,
let us see. I am sending the proposal today then in the same format with a
copy to [redacted] I have to give a reminder to [redacted] about
my enquiry on the subject of re-submitting the proposal for the next AUC
meeting. That's all for the moment. Not many people in VECC know about my
efforts to attend INPC-98. [redacted] and [redacted] have guessed but don't know the
latest status. I always try to share my good and bad events with you; so I
felt like giving you the status. I shall require some of the
transparencies back again for preparing some talks to be given at France.
This is not very urgent and I am anyway likely to come for the expt. in
July. I would take it then. Also, hopefully you don't have to present it
again. With best wishes,

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[redacted]
13h25
21/5/98

From [redacted] in Fri May 22 19:50:46 1998
Return-Path: [redacted]
Received: from [redacted] (4.1/SMI-4.1)
id AA27953; Fri, 22 May 98 19:49:59 IST
Received: from localhost by [redacted] (8.8.8/SMI-SVR4)
id TAA15576; Fri, 22 May 1998 19:45:30 -0500 (GMT)
Date: Fri, 22 May 1998 19:45:30 -0500 (GMT)
From [redacted]
To: Temp Area [redacted]
Subject: Re: Updates!
In-Reply-To: [redacted]
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
Status: O
X-Status:

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Dea [redacted]
Sometime back, I sent you a mail to rpsd. I hope you have
seen that. Sorry! I missed you. I was at that time sending follow-up mails
to [redacted] I came to know that [redacted] is also going to
send a proposal for [redacted] If there are more requests from Calcutta, I
don't know, whether we would get the time or not. That's why the follow-up
mail was required. I also sent by speed post the original in duplicate as
asked for to [redacted] You please confirm the receipt of the same
over phone from Vaze. To impress further for the desired dates, I have
indicated to [redacted] only that I might be out in August for INPC-98.
Regarding other points, you have written in your mail, I shall discuss
tomorrow, if we can connect one another. I am already late. Bye now.
With best wishes,

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[redacted]
22/5/98

From nobody@spm1.springer.de Sun May 24 17:08:09 1998

Return-Path: [redacted]
Received: from [redacted] (SGI) by [redacted] (4.1/SMI-4.1)
id AA07621; Sun, 24 May 98 17:08:01 IST
Received: from [redacted] via UUCP (940816.SGI.8.6.9/940406.SGI)
for [redacted] id RAA13422; Sun, 24 May 1998 17:10:14 +0530
Received: from relay4.UU.NET (relay4.UU.NET [192.48.96.14]) by [redacted] (8.7.5) with
ESMTP id QAA03953 for [redacted] Sun, 24 May 1998 16:28:01 +0530
(GMT+05:30)
Received: from [redacted] by relay4.UU.NET with SMTP
(peer crosschecked as [redacted] [192.129.25.2])
id QQeqsf29967; Sun, 24 May 1998 02:25:46 -0400 (EDT)
Received: from [redacted] with SMTP id AA04732
(5.67a8/IDA-1.5 for [redacted]) Sun, 24 May 1998 08:17:50 +0200
Received: by [redacted] (SMI-8.6/SMI-SVR4)
id IAA10093; Sun, 24 May 1998 08:25:14 +0200
Date: Sun, 24 May 1998 08:25:14 +0200
From: [redacted]
Message-Id: [redacted]
Reply-To: [redacted]
Subject: Springer LINK: Free test account
Apparently-To: [redacted]
Status: O
X-Status:

Your user ID: test0706
Your password: 0607aevc
Valid until June 07, 1998

From: [redacted] Wed May 27 14:53:39 1998
Return-Path: [redacted]
Received: from [redacted] (4.1/SMI-4.1)
id AA29104; Wed, 27 May 98 14:52:58 IST
Received: from localhost by [redacted] (8.8.8/SMI-SVR4)
id OAA28805; Wed, 27 May 1998 14:48:01 -0500 (GMT)
Date: Wed, 27 May 1998 14:48:00 -0500 (GMT)
From: [redacted]
To: Temp Area [redacted]
Subject: Re: your mail
In-Reply-To: [redacted]
Message-Id: [redacted]
Mime-Version: 1.0
Content-Type: TEXT/PLAIN; charset=US-ASCII
Status: O

Dear [redacted]

Just now saw your mail. I am sending you three separate files; a .tex file for manuscript with letter & answers to referee's comments, a .ps file for fig.1 and a .eps file for fig.2; Usually, it goes to the same referee and if he is not very much biased and if he does not take much offence in the corrections we did in rel. ints., it should get accepted. Pl. give some re-thinking on what we have written on 143Pm. [redacted] is on the job and I am also trying to assist him to get through the calculations. today, I sat for sometime and gave him some clues to test on 142Nd first and then to apply to 143Pm. 142Pm we would take up later. if you are coming in July end, you may probably get a running code to play further with it from there. Nothing more at the moment. Give feedback of

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your meeting with [redacted] Bye now.

[redacted]
14h50
27.5.98

From [redacted] Wed May 27 15:06:58 1998
Return-Path: [redacted]
Received: from [redacted] (4.1/SMI-4.1)
id AA29183; Wed, 27 May 98 14:55:15 IST
Received: by [redacted] (8.8.8/SMI-SVR4)
id OAA28857; Wed, 27 May 1998 14:50:31 -0500 (GMT)
Date: Wed, 27 May 1998 14:50:31 -0500 (GMT)
From: [redacted]
Message-Id: [redacted]
To: [redacted]
Subject: prclett2.tex File
Status: O

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\documentstyle[prc,aps]{revtex}
\title{High spin states in doubly-odd ^{142}Pm }
\author{[redacted] \cite{byline}}
\address{Bhabha Atomic Research Centre, Mumbai 400085, India}
\author{[redacted] footnote
{Contributing author -- e-mail: [redacted]
\address{Variable Energy Cyclotron Centre, Calcutta 700064, India}
\author{[redacted]
\address{Nuclear Science Centre, New Delhi 110067, India}}

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\begin{document}
\pagenumbering{roman}
\rightline{May 26, 1998}

\noindent
{\bf{THE EDITOR }}
Physical review C \\
The American Physical Society \\
1, Research Road, Box 9000 \\
Ridge, NY 11961-9000 \\
U. S. A. }}

\vskip 0.5cm
Attn: {\underline{\bf{[redacted] Senior Assistant to the Editor.}}}

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\vskip 0.5cm
\noindent
Dear Sir,

\vskip 0.2cm
\noindent
Sub: {\underline{Your e-mail, dt. April 22, 1998, conveying Referee
Report on manuscript, having ref no. {\bf{CQJ633.}}}}

\vskip 0.5cm
This has reference to your above-referred e-mail, conveying the
report of the referee, on our {\bf{"Brief Reports"}} contribution,

entitled, {\bf{"High spin states in doubly-odd ^{142}Pm "}} by [redacted] and others, for publication in {\bf{Physical Review C - Nuclear Physics section}}, under the heading {\bf{"Nuclear Structure"}}. It is gratifying to note that the referee has acknowledged the fact that a considerable extension of the previously known level scheme of ^{142}Pm has resulted due to our reasonable experimental work. We are thankful to the referee for his kind comments and suggestions, that was very useful in increasing the transparency in the manuscript. Below please find the "Answers and Comments to Referee's Report" alongwith the revised manuscript for your perusal. I shall be highly obliged if you kindly give due consideration to the revised manuscript for publication in your journal at an early date.\\

Thanking you. \\
Yours sincerely, \\

\\skip 0.5cm

\\noindent

Adress for correspondence: \\

[redacted] \\
Scientific Officer (G) \\
Variable Energy Cyclotron Centre \\
1/AF, Bidhan Nagar \\
Calcutta - 700 064 \\
Tel [redacted] \\
Fax [redacted] \\
e-mail: [redacted]

\\pagebreak

\\underline{{\bf{Answers & Comments to Referee's Report}}}

\\skip 0.5cm

1. As suggested, the description of the experimental set-up has been elaborated in para. 2, in order to make it more transparent to readers. It is true that the reference cited in connection with the set-up, describes an earlier version of the array. This has been indicated in the revised text.

2. Though the definition of DCO ratio has not been explicitly given, it is clear from the relevant portion of the text in page 5, that we have used the definition, as given below, viz., $R_{\text{DCO}}(\gamma_1) = I(\gamma_1) \text{ at } 153 \text{ keV (or } 45 \text{ keV), gated by } \gamma_2 \text{ at } 99 \text{ keV} / I(\gamma_1) \text{ at } 99 \text{ keV gated by } \gamma_2 \text{ at } 153 \text{ keV (or } 45 \text{ keV)}$. This gives for a pure quadrupole gate: $R_{\text{DCO}} = 1.0$ for quadrupole transitions; = 2.0 for dipole transitions. As the manuscript has been planned as a Brief Report, the explicit definition of DCO ratio was not given, considering the size restrictions. However, as the referee feels that it should be given, we have included it in the relevant portion of the text in page 5.

3. In response to referee's comments on PACE2 calculations, mentioned in page 4 of the earlier version of the manuscript, we have incorporated in the revised text the relative normalised yields of the observed channels

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and compared the same with the calculations by PACE2 code. It may be remarked that the PACE2 calculation was used as a guide to decide the proper projectile energy for coincidence experiment. It is true that the identification of the reaction channels in our case was done by gating with known γ -rays of the channels and not by evaporated neutrons or by the residual nuclei; comparison with PACE2 calculation is used more as a qualitative check of the expected channels at the chosen projectile energy.

4. The spin-parity assignments in the present work rest on the assumption of the multipolarity of the 991.7 keV transition to be E2. Though this assumption is found to be consistent from other gates, such as, 142.9 and 221.5 keV gates, we still preferred to keep the spin-parity of 10^+_{γ} , 11^+_{γ} , 13^+_{γ} and 15^+_{γ} levels as tentative in the earlier version of the manuscript. However, on being pointed out by the referee, we have removed the word, "tentative" in the revised version, so that no correction in Table I and Fig. 2 is necessary.

5. On scrutiny, it has been found that the relative intensity of 175.3, 330.0 and 742.6 keV has been erroneously entered in Table I, from the table of relative intensity values, estimated from the singles spectrum. Of these, 175.3 and 742.6 keV are contaminated by transitions belonging to ^{141}Pm and ^{139}Pr respectively and the corresponding relative intensity values have been appropriately corrected. The values obtained after correcting for the said contaminations, have now been included in the revised table. The problem of intensity balance in case of 1940.6 keV level, as pointed out by the referee, does not exist any more.

6. The referee has correctly pointed out the error in rounding the energy of 192 keV transition in fig. 1. The necessary corrections have been made in the said figure. The 208.5 keV transition was placed in the level scheme at two places by [] et al., based on the coincidence spectra corresponding to 208.5 keV gate and the same is corroborated by our data. The two energies are not at all different and the 208.5 keV line is also not unusually broad in the singles spectrum, so that one can identify the same as a close doublet. So, we do not prefer to label it with (d) in fig.1.

7. As suggested by the referee, we have tried to give a better presentation of the main flux of γ -ray intensity above the 2ms isomer by appropriately modifying the width of the arrows in fig. 2.

8. Regarding the interpretation of the level scheme, we feel that as the extension of the level scheme above the 2 ms isomer is still not complete in all respects, (even the spin-parity assignments in most cases are either tentative or could not be made due to poor statistics) and as further work is being planned, it would be too early to attempt an in-depth theoretical interpretation of the new levels. It is true that in the construction of the level scheme, reference was made to the available data of the neighbouring isotopes and isotones (as mentioned in the last line of page 4). It is, however, difficult to make a

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meaningful comparison with the structure of the said isotopes or isotones, primarily because the high spin data is rather scanty for $N=81$ odd-odd isotones and the published level schemes of odd-odd Pm isotopes on either side of ^{142}Pm have been observed to be very much different due to the different subshell for the valence neutron, above and below ^{146}Gd . Therefore, only a modest revision of the last paragraph has been attempted keeping in view the size limitation for a brief report communication. Accordingly, we have replaced the last statement in the abstract by a more general sentence.

\pagebreak
\pagenumbering{arabic}
\date{\today}
\maketitle
\begin{abstract}

The high spin states in the $N = 81$ odd-odd ^{142}Pm have been investigated by in-beam γ -spectroscopic techniques following the $^{133}\text{Cs}(^{13}\text{C},4n)^{142}\text{Pm}$ reaction at $E = 63$ MeV using a gamma detector array, consisting of 12 Compton-suppressed high purity germanium detectors and a multiplicity ball of 14 bismuth germanate elements. Thirty new γ -rays have been assigned to ^{142}Pm on the basis of the γ -ray singles and γ - γ coincidence data. The level scheme of ^{142}Pm has been extended upto an excitation energy of 5.1 MeV above the 2 ms isomer at 883.0 keV and spin-parity assignments for several levels have been done using the measured directional correlation orientation ratios for strong transitions. The proposed level structure is discussed in the light of available systematics for the neighbouring odd-odd $N=81$ isotones.

\end{abstract}

\pacs{PACS number(s): 21.10.-k; 23.20.-g; 27.60.+j }

The doubly-odd Pm-nuclei with $Z=61$ and $N \leq 80$ have been studied in recent years using heavy ion reactions [1,2,3,4]. The neutron Fermi surface in these nuclei is near the $1h_{11/2}$ orbit and the steeply sloping orbital energetically favours a move from sphericity destroying the effects of $Z=64$ sub-shell closure at modest deformation. This, in turn, helps promotion of protons into the $1h_{11/2}$ orbit at a modest excitation energy to induce further collectivity in the system. Band structures built on $1h_{11/2}$ single proton states have been observed in several odd-A Pm-nuclei in this mass region [5,6]. Configurations involving two $1h_{11/2}$ protons have also been identified [7] in ^{142}Nd and the involvement of $1h_{11/2}$ proton pair excitations in the high spin states in ^{144}Pm has been demonstrated [8]. Recently, high spin yrast isomers have been discovered in the $N = 83$ isotones, viz., ^{144}Pm [9], ^{145}Sm [10] and also in $N = 82$ ^{145}Eu [11]. The near-spherical ^{142}Pm nucleus, however, has not been studied in detail [12] to higher spins and the effect of $Z=64$ sub-shell closure in this nucleus is yet to be investigated. The only information concerning the excited states in ^{142}Pm comes from the work of [] et al. [13] who studied the γ -rays and conversion electrons following the (p,n) and (d,2n) reactions on ^{142}Nd and proposed a level scheme upto 1.2

MeV excitation, consisting of a 2 ms $8\frac{1}{2}^+$ isomer at 883.0 keV. Of late, we have also investigated the $^{141}\text{Pr}(\alpha, 3n)^{142}\text{Pm}$ reaction [14] at $E=40\text{--}50$ MeV and observed significant trapping of the yield of this reaction at the 2 ms isomer, which prompted us to undertake the present investigation using heavy ion reaction. To our knowledge, there exists no data on higher spins in the literature for ^{142}Pm using heavy ion reactions except an unpublished report by [] et al. in Nuclear Data Sheets [12] on ^{142}Pm isomers using $^{135}\text{Ba} + ^{11}\text{B}$ and $(\alpha, 3n)$ reactions.

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High spin states in odd-odd ^{142}Pm were populated in the present work through the reaction $^{133}\text{Cs}(^{13}\text{C}, 4n)^{142}\text{Pm}$ at $E=63$ MeV. The ^{13}C beam (≈ 2 pnA) was obtained from the 15UD Pelletron Accelerator of Nuclear Science Centre (NSC), New Delhi. The target (≈ 3.5 mg/cm ^{2}) was prepared by centrifuge method using specpure (99.999%) $^{133}\text{CsNO}_3$, supplied by ALDRICH, USA. A 5mg/cm ^{2} Au-foil was used as backing and the target was covered from top with a 200 $\mu\text{g/cm}^2$ evaporated Au-film. The γ -ray de-excitations were studied using the Gamma Detector Array (GDA), which consists of twelve 23% n-type Compton-suppressed HPGe detectors (CSS), each positioned at a distance of 180 mm from the target, along with a multiplicity ball of fourteen hexagonal (38mm x 75mm) bismuth germanate (BGO) detectors, placed in closed-packed geometry above and below the target chamber and covering about 35% of the total solid angle. The CSS's are arranged on two horizontal rings at $\pm 25^\circ$ to the median plane. Six detectors are put on each ring, symmetrically on both sides of the beam line so that there are altogether three groups of four detectors with each group subtending angles of 45° , 99° and 153° respectively at the target centre. The anti-Compton shields are of symmetric design consisting of eight optically isolated BGO crystals with conical NaI(Tl) nose segments for better suppression of back-scattered photons. Any direct radiation from the target onto the shield is guarded against by 30mm thick heavy metal (tantalum alloy) collimators, placed between each detector and the target. An earlier version of the array and the associated data acquisition system have been described in Ref. [15]. Around 66 million two and higher fold coincidence events were recorded in list mode. Each coincidence event was qualified with the condition that at least one BGO detector of the multiplicity ball should fire. The pulse height of each detector was gain matched to 0.5 keV/channel and the γ - γ coincidence data were sorted out into a 4096x4096 total E_{γ_1} - E_{γ_2} matrix from which the energy spectra gated by the γ -rays of interest were generated. The γ -rays from the various expected channels, viz., $^{141,142,143}\text{Pm}$ and ^{139}Pr were identified by putting gates on several known transitions. The estimated relative yields (in mb) of the various observed channels have been compared below with the same (given within bracket), obtained from PACE2 calculations [16]: $^{141}\text{Pm} = 163$ (187); $^{142}\text{Pm} = 570$ (593); $^{143}\text{Pm} = 90$ (14) and $^{139}\text{Pr} = 18$ (33). The agreement seems to be reasonable within the uncertainty in the estimated yield of ^{10}B , except for ^{143}Pm . Thirty new γ -rays, besides those seen in $(\alpha, 3n\gamma)$ reaction [14], have been assigned in ^{142}Pm on the basis of the coincidence relationship between themselves and with the K-xrays of Pm. Some of these γ -rays were also seen in our $(\alpha, 3n\gamma)$ work [14] and were tentatively identified in ^{142}Pm from the relative

γ -ray excitation function data. The placement of the new transitions above the 2 ms 8^+_{γ} isomer is decided by the fact that none of these γ -rays are in coincidence with either the strong γ -rays of the neighbouring channels, seen in the present work or with the known γ -rays of ^{142}Pm below the 2 ms isomer [13,14]. This is demonstrated in fig.1, where the added coincidence spectra, corresponding to 208.5 and 241.0 keV gates and 991.7, 142.9 and 221.5 keV gates respectively, are displayed. The placement of 208.5 and 241.0 keV transitions below the 2 ms 8^+_{γ} isomer is well established from light ion experiments [13,14]. The other three transitions are placed above the said isomer in the present work. Table I gives a summary of the new transitions and other related data concerning their assignments in the proposed level scheme (fig.2). Because of the presence of overlapping γ -rays from the competing channels, the relative intensities have been determined from the total projected as well as individual gated spectra. On the basis of the observed coincidence relationship, the intensity balance and the known systematics in the neighbouring isotopes and isotones, the level scheme of ^{142}Pm has been constructed. For completeness, the low-lying level scheme, as observed in the present work, is also included in the same figure. This scheme is well corroborated by the same proposed in earlier light ion experiments [12,13,14] except for the low spin negative parity ones above the 2 ms isomer. These states are not seen in the γ - γ coincidence spectra because of the weak population of the corresponding states in heavy ion reaction and the trapping of the major feeding at 2 ms isomer. The spin-parity assignments of some of the proposed levels have been done on the basis of the deduced multipolarities of the strong transitions from the measured directional correlation orientation (DCO) ratios. For this purpose, two separate 4096×4096 E γ -E γ matrices were generated from the events in which one of the detectors at 99 γ group were observed in coincidence with one from the detectors at either the 153 γ or the 45 γ group respectively. The DCO ratio was determined using the expression: $R_{\text{DCO}}(\gamma_1) = I(\gamma_1) \text{ at } 153\gamma \text{ (or } 45\gamma \text{), gated by } \gamma_2 \text{ at } 99\gamma / I(\gamma_1) \text{ at } 99\gamma \text{ gated by } \gamma_2 \text{ at } 153\gamma \text{ (or } 45\gamma \text{)}$. In absence of any prior knowledge about the multipolarity of the assigned γ -rays from complimentary measurements, the DCO ratios corresponding to 991.7, 142.9 and 221.5 keV gates have been compared. It is observed that the DCO ratios can be divided into two groups, centered around the value expected for stretched quadrupole ($R_{\text{DCO}} = 1.0$) and stretched dipole ($R_{\text{DCO}} = 2.0$) transitions for a corresponding gate of E2 multipolarity. This feature favours E2 multipolarity for 991.7, 142.9 and 221.5 keV transitions. In some cases, particularly for transitions which are contaminated by the γ -rays from the competing channels, the multipolarities of cross-over and cascade transitions are used for tentative spin-parity assignments. A 241.3 keV γ -ray has been definitely seen in coincidence with the 991.7, 278.0 and 330.0 keV transitions which necessitates its placement above the 1874.7 keV level. A detailed analysis of the spectra gated by the region around the 192 keV multiplet confirms the placement of the 192.4 and 195.2 keV γ -rays above the 1381.8 and 1378.9 keV transitions respectively. Some of the transitions, which were assigned by the previous workers either in ^{141}Pm [17,18,19] or in ^{143}Pm [20,21,22], have been included in the present level scheme on the basis of the coincidences observed in the 991.7, 142.9 and 221.5 keV gates. Of these,